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FREEZE-DRIED MICROENCAPSULATION OF VIENNOISERY FLAVOUR WITH GUM ACACIA AND MALTODEXTRINS

Flavours can be among the most valuable ingredients in any food formula. Even small amounts of some aroma substance can be expensive, and because they are usually delicate and volatile, preserving them is often a top concern of food manufacturers.

Encapsulation which describes different processes to cover an active compound with a protective wall material, can be employed to convert flavours to an impart some degree of protection against evaporation, reaction, or migration in a food. Encapsulation of aromas has been commercialized using many different methods such as spray–drying, spray–chilling, or spray–cooling, extrusion, freeze–drying, coacervation and molecular inclusion (Dziezak, 1988).

Freeze–drying technique is one of the most useful processes for drying thermosensitive substances that are unstable in aqueous solutions. This method occurs at low temperatures and under vacuum, avoiding any water phase transition and any oxidation (Jacquot & Pernetti, 2004). The dried mixture thus obtained must be grounded, resulting in heterogeneous particles with a low surface area, if compared to spray–drying.

In selecting the wall materials for encapsulation, maltodextrin in a good compromise between cost and effectiveness, as it is bland in flavour, has low viscosity at a high solid ratios and is available in different average molecular weights (Apintanapong & Noomhorm, 2003). Their major shortcomings are a virtual lack of emulsifying capacity and low retention of volatiles compounds (Reineccius, 1991). Mixtures of gum Arabic and maltodextrin showed promise as high solid carriers, giving acceptable viscosity in studies on microencapsulation (Sankarikutty et al., 1988).

Minemoto et al., (1997) compared oxidation of menthyl linoleate encapsulated with gum rabic by spray–drying and freeze–drying. These authors showed that freeze–drying was better than spray–drying. Indeed, the menthyl linoleate encapsulated by freeze–drying was more slowly oxidized at any relative humidity and the fraction for the microencapsules did not change during storage.

OBJECTIVES

The subject of research is part of the CANAL project (Conception Assistée des Nouveaux Aliments). The objective of the network, which regroups several university and industrials, is principally studying and comprehending of flavour–food–packaging interactions. In the research subject, the partners privates implicate are : ENSAIA, Nancy, ENSBANA, Dijon, Montpellier university II and INRA Massy. The partners industrials are : Ahlstrom Research and Services, Pont–Ev“que, and Danone Vitapole, Palaiseau.

The composition of viennoisery aroma are : ethyle acetate, dihydrocoumarine, propylene glycol, sulfurol, vanilline, ethyle butyrate, ethyle caproate, acide C04 butyrique, acide C10 caprique, hexenol cis 3, acide C06 caproique, methyle cinnamate, gamma decalactone, acetyl methyl carbinol, furaneol, maltol, benzoique aldehyde, citral and diacetyle.

The packaging which used for studying the interactions with viennoisery aroma is : 2 papers : Rocal (barrier for water vapour) and Ascoflex (barrier for oxygen and water vapour); and 2 plastics : bOPP (bi–oriented polypropylene) and bOPPM (bi–oriented polypropylene metal).

The food matrix : sponge cake model.

MATERIAL AND METHODS

Wall and core materials. A commercial gum acacia (*Acacia Senegal*) was supplied by CNI (Rouen, France). Maltodextrin with dextrose equivalent DE– 18 was purchased. The flavour system consisted of viennoisery aroma (containing 20 components), provided by Danone, (Dijon, France).

Emulsion preparation. Wall solutions containing were dissolved in distilled water by heating to 82C. Solids concentrations were 20% (w/w) for each carrier. The flavour:carrier ratio was 1:4, 1:5, 1:7, 1:10 and 1:20. Emulsion assays were realized with samples of 50mL. Emulsifications were carried out by using an Ultra–Turrax

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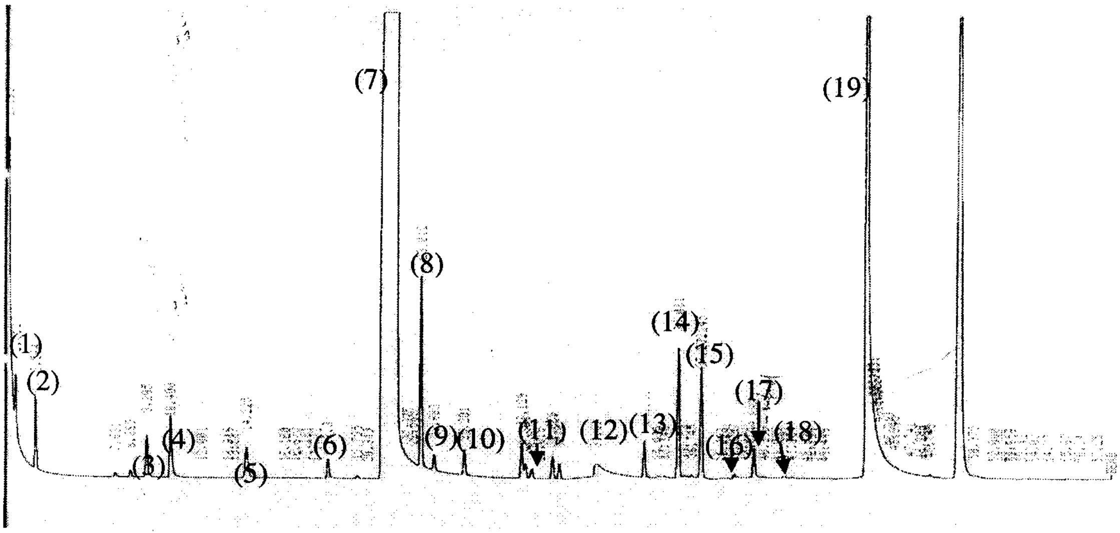

Figure 1. Aroma component profile from native viennoisery flavour obtained with gas chromatography.
(1): diacetyle, (2): butanoate d'ethyle, (3): hexanoate d'ethyle, (4): acetoine (2–hydroxy–2–butanone), (5): 3–hexenol–1–ol, (6): benzaldehyde, (7): propylene glycol, (8): acide butanoique, (9): geranial, (10): neral, (11): acide hexanoique, (12): maltol, (13): furaneol, (14): cinnamate du methyl, (15): alpha–decalactone, (16): delta–decalactone, (17): 3,4 dihydrocoumarine, (18): sulfurol, (19): vanilline.

T–25 homogenizer (IKA Janke and Kunke model Bioblock Scientific, Illirch, France) operated at 20500 rpm for 5 min. Following, the emulsions were stored at –20°C for 20 h. The dried powders were stored at 4°C until they were analysed.

Freeze–Drying. A laboratory scale freeze–drying equipment was used to dry the frozen emulsion, The samples were freeze–dried in glass–bottles at –60°C for 48 h.

Aroma components profile. The profiles of flavour components in the powder were verified by means of a solvent extraction method. 5 g of powder was dissolved in 10 mL of water and 1 mL of HCl (0.1N) in glass bottle, followed by adding 0.5 mL of dichloromethane, and violent mixing with a vortex mixer for 1 min. To extract the flavour, the mixture was centrifuged at 4000 rpm for 10 min. The content of flavour in the organic phase was measured by gas chromatography. A gas chromatograph equipped with an FID. A capillary column, 30 m x 0.25 mm x 0.25 μm, was operated with the following temperature program : 40°C for 5 min, raised at 4°C/min to 240°C, held for 10 min. Helium was used as the carrier gas.

FIRST RESULTS

The profile of native viennoisery aroma (without encapsulation) is showed in Figure 1.

PERSPECTIVES

- Characterisation of emulsions: viscosity and particle size of droplets.
- Characterisation of flavour capsules: moisture content, density, particle size, morphology of capsules, total oil, flavour load and shelf life.
- Characterisation of packaging: permeability of oxygen and water vapour, isotherm of sorption.
- Fabrication of sponge cake model: formulation, fabrication and quantification of aromas in cake matrix.
- Comprehension of flavour encapsulated–cake matrix–packaging–environment.
- Sensorial analysis.

REFERENCE

[1] Dziezak, J.D., Microencapsulation and encapsulation ingredients. Food Technology, **42** (1988) 136–151.

[2] Jacquot, M. & Pernetti, M., Spray coating and drying processes. In: Fundamentals of Cell Immobilization Biotechnology (edited by V. Nedovic and R. Willaert). Series: Focus on biotechnology. Kluwer Academic Publishers, (2004) pp. 343–356.

[3] Apintanapong, M. & Noonmhorm, A., The use of spray–drying to microencapsulate 2–acetyl–1–pyrroline, a major flavour component of aromatic rice. International Journal of Food Science and Technology, **38** (2003) 95–102.

[4] Reineccius, G.A., Carbohydrates for flavour encapsulation. Food Technology, **45**(3) (1991) 144–147.

[5] Sankarikutty, B., Sreekumar, M.M., Narayanan, C.S. & Mathew, A.G., Studies on encapsulation of cadamon oil by spray–drying technique. Journal of Food Science and Technology, **25** (1988) 352–356.

[6] Minemoto, Y., Adachi, S. & Matsuno, R., Comparaison of oxidation of menthyl linoleate encapsulated with gum Arabic by hot–air–drying and freeze–drying. Journal of Agricultural and Food Chemistry, **45** (1997) 4530–4534.